QUICK-CONNECT CHUCK MECHANISM

FIELD OF THE INVENTION

[0001] The present invention relates generally to power tools and accessories. More particularly, the present invention relates to an improved chuck for use with a rotary and/or hobby tool.

BACKGROUND OF THE INVENTION

[0002] This invention relates to accessories for rotary tools. More specifically, this invention relates to mechanisms or chucks for retaining, preferably round shanked tool bits or accessories for preferably unidirectional rotary tools such as those sold under the Dremel, Black & Decker or Craftsman trademarks that offer conventional methods to achieve tool change and holding capability.

[0003] Due to problems associated with gripping and driving tool bits with round shanks, one known solution is via a collet and a tightening nut, which is rotated to secure the shank of the tool bit. The shortcoming of this design is the cumbersome and time-consuming tool changes. Generally, a spindle of the rotary tool is locked in one position and held there. A separate tool, such as an open-ended wrench, is used to engage the nut to loosen it from the collet. The tool bit or accessory is then removed from the tool. To install another accessory, the reverse operation is performed. The spindle is locked into place again and held in that position. The shank of the tool bit or accessory is inserted into the collet and the nut is tightened. An open-ended wrench is used to securely tighten the shank in the collet. As well as being too time-consuming, this method is also inconvenient since a user grasps the tool and locks the spindle in place, while simultaneously inserting the accessory into the collet and tightening the nut around the shank of the accessory. This method also requires the use of a separate tool to tighten and loosen the shank of the accessory from the collet.

[0004] Another method of attaching accessories to rotary tools is by using a three-jaw chuck. In this method, again, the spindle of the tool is locked into position, while the chuck is tightened on the shank of the tool bit or accessory. In some cases, a separate tool, such as a wrench or Allen key, is used to tighten or loosen the chuck once it has been finger-tightened. This method again requires the user to change the tool bit or

accessory using both hands when there are three areas the user must contact: the spindle, the shank, and the chuck.

[0005] There is a need for a mechanism that provides quicker tool changing yet equals or betters the mechanism's capability to hold the tool in its operation. There is also a need for a mechanism that does not require any extra tools for operation.

[0006] It is, therefore, desirable to provide an improved chuck for a use with a rotary tool.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to obviate or mitigate at least one disadvantage of previous chucks for rotary tools by providing a chuck that accommodates and provide torque to tools with preferably round shanks.

[0008] In a first aspect, the present invention provides a chuck for retaining the shank of a tool bit or accessory inserted in a central channel at a distal end of said chuck, comprising at least one torsion spring mounted axially within a housing and having an inner dimension and shape comparable to said shank's outer dimension and shape, and mechanical means for winding and unwinding said torsion spring to respectively grip or release said shank, said winding being in a rotational direction consistent with a normal operating rotational direction of said chuck such that said shank tends to further wind said torsion spring for further self-tightening in normal operation.

[0009] In another aspect, the present invention provides a chuck for retaining the shank of a tool bit or accessory inserted into a central channel at a distal end of said chuck comprising a collet with at least two jaws mounted axially within a moveable sleeve, axial movement of said sleeve in one direction causing expansion of said at least two jaws to permit tool bit removal and axial movement in a second direction causing gripping of said tool bit by said device.

In yet a further embodiment, the present invention provides a chuck for retaining the shank of a tool bit or accessory inserted into a central channel at a distal end of said chuck comprising a collet with at least two jaws mounted axially within a moveable sleeve, fractional rotational movement of said sleeve in one direction causing expansion of said at least two jaws to permit tool bit removal and fractional rotational movement in a second direction causing gripping of said tool bit by said device.

[0010] Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Embodiments of the present invention will now be described, by way of example only, with reference to the attached Figures, wherein:

Fig. 1 is an exploded view of a first embodiment of a chuck for use with a rotary tool;

Fig. 2a is a side view of a torsion spring used in the first embodiment of the chuck;

Fig. 2b is an isometric view of the torsion spring used in the first embodiment of the chuck;

Fig. 3a is an isometric view of an inner housing for the first embodiment of the chuck;

Fig. 3b is an isometric view of the inner housing;

Fig. 4a is an isometric view of a sleeve used in the first embodiment of the chuck;

Fig. 4b is a transparent isometric view of the sleeve;

Fig. 4c is a sectional view of the sleeve;

Fig. 5a is an isometric view of the end cap of the first embodiment of the chuck;

Fig. 5b is a side view of the end cap;

Fig. 6a is a cross-sectional view of the first embodiment of the assembled chuck in the locked position with a tool bit or accessory;

Fig. 6b is a cross-sectional view of the end of the assembled chuck in the locked position with a tool bit or accessory;

Fig. 7a is a cross-sectional view of the assembled chuck in the open position;

Fig. 7b is a cross-sectional view of the end of the assembled chuck in the open position;

Fig. 8 is a cross-sectional view of the second embodiment of the chuck for a rotary tool in the locked position;

Fig. 9 is a cross-sectional view of the end of the second embodiment of the chuck for a rotary tool in the locked position as indicated in Fig. 8;

Fig. 10 is a cross-sectional view of the second embodiment of the chuck for a rotary tool in the open position;

Fig. 11 is a detail drawing of the torsion spring as indicated in Fig. 10;

Fig. 12 is a cross-sectional view of the end of the second embodiment of the chuck for a rotary tool in the locked position as indicated in Fig. 10;

Fig. 13 is a cross-sectional view of the second embodiment of the chuck for a rotary tool in the open position with the tool bit or accessory removed;

Fig. 14 is a cross-sectional view of the inner housing of the second embodiment of the chuck;

Fig. 15 is a side view of the inner housing of the second embodiment of the chuck;

Fig. 16 is an end view of the inner housing as shown in Fig. 15;

Fig. 17 is a side view opposite that of Fig. 15 of the inner housing of the second embodiment of the chuck;

Fig 18 is an end view of the inner housing as shown in Fig. 17;

Fig. 19 is an isometric view of the inner housing of the second embodiment of the chuck;

Fig. 20 is a side view of the sleeve of the second embodiment of the chuck;

Fig. 21 is a cross-sectional view of the sleeve as shown in Fig. 20;

Fig. 22 is an isometric view of the sleeve of the second embodiment of the chuck;

Fig. 23 is a sectional view of the sleeve as shown in Fig. 22;

Fig. 24 is an end view of the torsion spring of the second embodiment of the chuck;

Fig. 25 is a side view of the torsion spring as shown in Fig. 24;

Fig. 26 is an isometric view of the inner housing and the torsion spring of the second embodiment;

Fig. 27 is a sectional view of the inner housing with the sleeve in the locked position;

Fig. 28 is a sectional view of the inner housing with the sleeve in the open

position;

Fig. 29 is a detailed view of the torsion spring within the innerhousing;

Fig. 30 is a cross-sectional view of a third embodiment of the chuck in the open position;

Fig. 31 is a cross-sectional view of a third embodiment of the chuck with a tool bit or accessory in the locked position;

Fig. 32 is a cross-sectional view of the third embodiment of the chuck in the locked position;

Fig. 33 is an exploded view of the third embodiment of the chuck;

Fig. 34 is a cross-sectional view of a fourth embodiment of the chuck in the open position;

Fig. 35 is a cross-sectional view of the fourth embodiment of the chuck in the locked position;

Fig. 36 is a side view of the spring used in the third and fourth embodiment of the chuck;

Fig. 37 is an isometric view of the spring as shown in Fig. 36;

Fig. 38 is a bottom view of the spring in Fig. 36;

Fig. 39 is a cross section of the inner housing of the fourth embodiment of the chuck;

Fig. 40 is an end view of the inner housing as shown in Fig. 39;

Fig. 41 is a side view of the sleeve of the third and fourth embodiment of the chuck;

Fig. 42 is an end view of the sleeve shown in Fig. 41;

Fig. 43 is an end view of the tool bit or accessory used in the fourth embodiment of the chuck;

Fig. 44 is a side view of the tool bit or accessory shown in Fig. 44.

Fig. 45 is a side view of the inclined plate used in the third and fourth embodiment of the chuck;

Fig. 46 is an end view of the inclined plate shown in Fig. 45;

Fig. 47 is a cross-sectional view of the end cap used in the third and fourth embodiment of the chuck;

Fig. 48 is an end view of the end cap shown in Fig. 48;

Fig. 49 is a cross-sectional view of a fifth embodiment of the chuck in the

locked position with a tool bit or accessory.

Fig. 50 is a sectional of a sixth embodiment of the chuck.

DETAILED DESCRIPTION

[0012] Generally, the present invention provides an improved chuck for a rotary tool.

[0013] Turning to Figure 1, an exploded view of apparatus of a chuck for a rotary tool is shown. The chuck **10** comprises an inner housing **12**, a compression, or biasing, spring **14**, a second spring **16**, such as a torsion spring, a mid spacer **18**, an end spacer **20**, an inclined plate **22**, a sleeve **24**, an end cap **26** and a spring cap **28**. As will be explained in greater detail later, the mid spacer **18**, the end spacer and the inclined plate **22** are strictly optional features.

[0014] As shown in Figures 2a and 2b, the torsion spring **16** comprises a pair of spring sections **30a** and **30b**, each having an end tang **32a** and **32b**, which are connected to each other via a moveable tang portion, such as a central tang **34**. In another embodiment, a pair of springs comprising a central tang and a pair of end tangs may also be used.

[0015] Figures 3a and 3b provide more detailed schematics of the inner housing **12**. Figure 3a is a perspective view of the top of the inner housing and Figure 3b is a perspective view of the bottom of the inner housing **12**. The inner housing **12** comprises a first end **36** for receiving a shank of a tool bit or accessory and a second end **38** for attachment of the chuck **10** to a power tool. Examples of a tool bit or accessory include a drill bit, a mandrel or a grinding tool.

[0016] The first end **36** is preferably a cylindrical tube comprising a tang slot **40**, preferably manufactured by milling, for receiving the end tangs **32a** and **32b** and the central tang **34** of the torsion spring **16** along with a central channel **42** for receiving the two spring sections **30a** and **30b**. The tang slot **40** comprises a radial, or circumferential, slot **44** for housing the central tang **34** after the torsion spring **16** has been inserted into the channel **42**. The hole **44** provides an area for the central tang **34** to rotate when the sleeve is moved (as will be described below) along with an area for the central tang **34** to rotate in order to tighten the torsion spring **16** around the shank of the tool bit or accessory. After the torsion spring **16** has been inserted into the first end **36** of the inner

housing **12**, the spring cap **28**, preferably a polymer cylinder, is fitted atop the central tang **34**. The spring cap **28** provides protection to the central tang **34** from wear and tear against the sleeve and to reduce friction between the central tang **34** and the sleeve **24**. Alternatives to the polymer cylinder include an oilite-type cylinder or any other bushing that is lubricant-impregnated.

[0017] The mid spacer **18** is placed between the two springs sections **30a** and **30b** to provide stability to the shank of the tool bit or accessory when the tool bit or accessory is inserted into the chuck. The mid spacer **18** also provides support for short shanks or shanks that have not been inserted to a required depth. The mid spacer **18** preferably has an outer diameter smaller than the diameter of the central channel **42** and an internal diameter slightly larger than that of the shank of the tool bit or accessory. Although the term diameter has been used to describe the apertures within which the shank of the tool bit or accessory is received, other dimensions may be used depending on the shape of the outer dimension of the shank.

[0018] A ridge, corresponding to the dimension of the end of the shank, which is cylindrical in the preferred embodiment but may be any shape such as notched or non-cylindrical, within the central channel **42** acts as a stopper to prevent the torsion spring **16** from entering the second end **38** of the inner housing **12**. The inner diameter of the ridge is also sized to provide stability to the shank of the tool bit or accessory. An end portion, seen as a pair of prongs **46**, is located opposite the annular ridge for connection with the end cap **26** when the chuck **10** is assembled.

[0019] The first end **36** of the inner housing **12** further comprises a second slot **48**, seen as an alignment slot, for receiving an aligner such as a key. The key is preferably formed integral to the inside of the sleeve **24** as will be discussed in more detail below. The location of the alignment slot **48** is generally opposite to and substantially equal in length with the tang slot **40**.

[0020] The second end **38** of the inner housing **12** comprises a shoulder **50** having a diameter larger than the outer diameter of the first end **36**. The shoulder **50** comprises a centrifugally movable means, seen as a set of holes **52**, each containing a spherical ball, preferably six, arranged at predetermined intervals around the surface of the shoulder **50**. The centrifugally movable means prevent axial displacement or removal of the sleeve during use. A pair of flats **54** is also milled on the side of the shoulder **50**

away from the first end **36** to assist in the tightening of the second end **38** onto the spindle of the power tool.

[0021] The compression spring **14** is assembled over the cylindrical tube of the first end **36** and has one end abutting the shoulder **50** and its other end abutting a shoulder **64** within the sleeve **24**. It will be understood that the compression spring **14** is assembled over the cylindrical tube before the torsion spring **16** is inserted into the central channel **42**.

[0022] Turning to Figures 4a to 4c, more detailed schematics of the sleeve **24** are shown. Figure 4a is a perspective view from an end of the sleeve **24**. Figure 4b is a perspective view of the sleeve with broken lines indicating details within the sleeve **24** and Figure 4c is a sectional view of the sleeve **24**. The sleeve **24**, which is preferably cylindrically shaped, comprises a first end **54** having an inner diameter which is less than the inner diameter of a second end **56**.

[0023] The first end **54** of the sleeve **24** receives the end cap **26** while the second end **56** is shaped to form an inclined face **58** adjacent a straight-walled cross-section **60**. An annular recess **62** is formed in the sleeve **24** to create the shoulder **64** along with a cam **66**, which in the present embodiment is helical. The shoulder and the internal cam within the sleeve assist in providing mechanical means for winding and unwinding the torsion spring **16**.

[0024] The sleeve **24** may be manufactured in a variety of methods including pressing, powder metal, injection moulding, die-casting, machining or a combination thereof but in the preferred embodiment is a die-cast piece. The preferred embodiment further comprises an aligner **44**, formed on the internal diameter of the sleeve **24**, sized to fit within the alignment slot **48** in the first end **36** of the inner housing **12**. The aligner **44** provides support when the chuck **10** is in use to prevent the sleeve **24** from unwanted rotational motion. The aligner also serves as a means to guide the sleeve when it is assembled over the inner housing.

[0025] When assembled to the inner housing **12**, the sleeve **24** is oriented so that the aligner **44** is inserted into the alignment slot **48** with the internal cam **66** contacting the spring cap **28** covering the central tang **34**. The sleeve **24** fits over the entire inner housing **12** to retain the spherical balls in the set of holes **52**, the compression spring **14**, and the aligner **44**.

[0026] Turning back to Figure 1, the optional inclined plate **22** is positioned adjacent to, and held in place by, the end spacer **20** to reduce accidental axial movement of the shank of the tool bit or accessory while the chuck **10** is in use. The inclined plate **22** is generally circular and has an internal diameter similar to the inner diameter of the mid-spacer **18** and the end-spacer **20**. A tab **68** extends from one edge of the inclined plate **22**.

[0027] The end cap **26**, shown in more detail in Figures 5a and 5b, comprises an outer diameter similar to the outer diameter of the sleeve **24** and an inner diameter similar to the inner diameter of the spacers. A hole **70** for receiving the shank of the tool bit or accessory is centrally located within the end cap **26**. An inside face **72** of the end cap is shaped to fit over the inclined plate **22** with a bottom half **74** of the inside face **72** being thicker than a top half **76** of the inside face **72** causing the inclined plate **22** to be inclined upon contact with the end cap **26**.

[0028] After the end cap **26** has engaged the second end of the sleeve **24**, the prongs **46** from the inner housing **12** are inserted into a set of prong holes **78** in the end cap **26** and permanently attached via swaging, welding, peening, adhesive bonding, a plastic clip, ultrasonic welding, spin welding, a retaining ring or staking.

[0029] Figures 6a and 6b provide schematic diagrams of an assembled chuck in a locked position while Figure 7a and 7b provide schematic diagrams of the assembled chuck in an open position.

[0030] In the locked position, the chuck **10** is generally at rest. As can be seen in Figure 6, the inclined face **58** and the cross-section **60** in the second end **56** of the sleeve **24** rests atop the shoulder **50** of the inner housing **12** to retain the spherical balls within the holes **52**. Furthermore, the first end **54** of the sleeve **24** rests against the tab **68** of the inclined plate causing the plate to be inclined against the inner face **72** of the end cap **26**. Rotation of the shank in a counter clockwise direction causes the torsion spring **16** to further tighten its grip on the shank by decreasing the internal diameter of the spring **106**.

[0031] In the locked position, both the compression spring **14** and the torsion spring **16** are uncompressed.

[0032] In order to insert a tool bit or accessory into the chuck **10,** the chuck **10** must be moved from the locked position to the open position. The chuck **10** is generally held in one hand and the sleeve **24** is retracted by the user in the direction indicated by arrow **80** of Figure 7a causing the compression spring **14** to become compressed. The

movement of the sleeve **24** also causes the spring cap **28** central tang **34** to travel along the helical cam **66**, within the hole **44**, increasing the internal diameter of the torsion spring **16** and enabling the removal and/or insertion of the shank of the tool bit or accessory into the end cap **26** and, subsequently, the first end **36** of the inner housing **12**. In general, the helical cam causes the torsion spring **16** to unwind thereby releasing the shank. The retraction of the sleeve **24** also allows the inclined plate **22** to return to a substantially upright position so that the shank may be inserted.

[0033] Upon release of the sleeve **24** by the user, the compression spring **14** is released causing the chuck **10** to return to the locked position. The sleeve may also, in the absence of the compression spring, be manually moved between the locked and open positions. Along with the compression spring **14**, the central tang **34** also biases the sleeve **24** back to the locked position by traveling back along the helical cam **66** within the hole **44**. Movement of the central tang **34** back along the cam **66** winds up the torsion spring **16** to decrease the internal diameter of the spring **16** thereby causing the torsion spring **16** to grip the shank of the tool bit or accessory. The grip is enhanced by the frictional forces between the internal dimension of the spring and the outer dimension of the shank. The torsion spring provides torque in a required rotational direction and increased torque application results in an increased gripping force to reduce torsional or axial slippage.

[0034] To further retain the shank from axial movement when the chuck is in use, the optional inclined plate **22** is used. This stability of the inserted shank is assisted by the spherical balls. During operation of the power tool, the rotation of the chuck **10** creates a centrifugal force causing the spherical balls to be urged outwardly against the sleeve **24** (as shown in Figure 6). This, in turn, results in the sleeve **24** being biased towards the end cap **26** placing a higher force against tab of the inclined plate **22** to further incline the inclined plate **22** against the inner face **72** of the end cap **26**. This, in turn, causes the inclined plate **22** to further bear on the shank of the tool bit or accessory.

[0035] Turning to Figures 8 to 29, schematic diagrams of second embodiment of a chuck for a rotary tool are provided. Figures 8 and 9 show the chuck in a locked position while Figures 10 to 12 show the chuck in an open position.

[0036] A chuck **100** comprises an inner housing **102** (shown in more details in Figures 14 to 19), a sleeve **104** (shown in more details in Figures 20 to 23) and a spring **106**, preferably a torsion spring, (shown in more details in Figures 24 to 25).

[0037] The torsion spring **106** comprises set of coils **108** with a pair of end tangs **110** and **112** located at opposite ends of the set of coils **108**. The pair of end tangs **110** and **112** point in opposite directions as illustrated in both Figures 24 and 25..

[0038] Turning to Figures 14 to 19, the inner housing **102** is shown in more detail. The inner housing **102** comprises a first end **114** for receiving a shank from a tool bit or accessory and a second end **116**, having a set of threads **118**, for attaching the chuck **100** to an external drive shaft of a rotary or power tool (not shown).

[0039] The first end **114**, seen as a cylindrical tube **119**, comprises a first, angular, slot **120** for receiving one of the end tangs of the torsion spring **106** and for guiding the movement of the torsion spring **106**. A second, alignment, slot **122**, slightly offset or opposite, from the angular slot **120**, receives the other end tang and aligns the torsion spring **106** within the first end **114** of the inner housing **102**. When the torsion spring **106** is placed into the first end **114** of the inner housing **102**, one of the end tangs **110** is inserted into the alignment slot **122** and the spring **106** is slid into a central channel provided by the cylindrical tube **119**. The other end tang **112** is then received by the angular slot **120** after the spring **106** has been complete inserted into the central channel.

[0040] The inner housing **102** also comprises an annular groove **121** for housing a retaining ring **123** (as shown in Figure 1) which prevents removal of the sleeve after assembly.

[0041] Turning to Figures 20 to 23, the sleeve **104** is preferably cylindrical and comprises a first end **124** having an opening **125** for receiving the shank of a tool bit or accessory and a second end **126** for receiving the inner housing **102**. Between the first end **124** and the second end **126** are an inner housing portion **130**, a spring portion **132** and a shank portion **134**. As shown in Figures 20 to 23, the inner housing portion **130** is larger in diameter than the spring portion **132**, which is larger in diameter than the shank portion **134**. This may be more clearly seen in Figures 21 and 23. Between the spring portion **132** and the shank portion **134** is a shoulder **136** which contacts the end tang **112** in the angular slot **120** (as shown in Figure 8).

[0042] The inner housing portion **130** generally surrounds the inner housing **102**, the spring portion **132** surrounds the torsion spring **106** and the shank portion **134** receives the shank of the tool bit or accessory via the opening **125** in the first end **124**.

[0043] In operation, the chuck **100** is generally in the locked position, as shown in Figures 8 and 9 or the open position, as shown in Figures 10 to 12.

[0044] In the locked position, the torsion spring **106** is uncompressed with the end tang **112** located at an edge of the angular slot **120** and the end tang **110** located in the alignment slot **122**. It will be understood that the end tang **110** may also be located in the angular slot **120** while the end tang **112** may be located in the alignment slot **122**. The uncompressed torsion spring **106** grips the shank of the tool bit or accessory in order to prevent the tool bit or accessory from falling out of the housing. As is known by one skilled in the art, the rotation of the shank of the tool bit or accessory is generally in a clockwise direction with respect to the user. Rotation of the shank in a counter clockwise direction causes the torsion spring **106** to further tighten its grip on the shank by decreasing the internal diameter of the spring **106**.

[0045] In order to change or remove the tool bit or accessory, the chuck **100** is placed in the open position. By retracting the sleeve **104** away from the tool bit or accessory, in the direction indicated by arrow **140**, the shoulder **136** contacts the end tang **112** and directs the end tang **112** along the angular slot **120** towards the opposite end of the angular slot **120**. Since the other end of the torsion spring **106** is restricted from moving by the inner housing (as shown in Figure 11), the torsion spring **16** is unwound as the end tang **112** is directed along the angular slot causing the internal diameter of the torsion spring **106** to increase. The movement of the sleeve **104** also causes the first end **114** of the inner housing **102** to protrude through the hole **125** in the sleeve **104**. The increase in the internal diameter of the spring **106** causes the grip of the spring **106** on the shank to loosen, allowing the shank to be removed. After the shank has been removed, the user may place another shank into the inner housing **102** via the opening **125** in the sleeve **104** as schematically showed in Figure 13. Release of the sleeve by the user causes the chuck to return to the locked position and the internal diameter of the torsion spring to decrease which allows the spring to grip the shank of the selected tool bit or accessory.

[0046] Figures 27 and 28 provide schematic views of the sleeve **104** and the inner housing **102** of the chuck **100** in the locked and open positions, respectively. Figure 29 is a schematic diagram of the inner housing with the end tangs **110** and **112** of the torsion spring **106** inserted into the alignment **122** and angular slots **120**. An arrow **182** displays the direction of travel by the end tang **112** when the chuck **100** is being moved from the locked position to the open position.

[0047] Figs. 30 to 48 show an alternative embodiment of the chuck using an inclined plate to capture the shank of a tool bit or accessory. This is similar in principle to the mechanism described in application no. **09/783,082**, filed February 15, 2001 and assigned to the present inventors' company, Maxtech Manufacturing Inc. In this embodiment, the chuck **200** has a sleeve **224** over an inner housing **201**, biased against an end cap **204** by a spring **202**, such as a compression, or biasing, spring. The inner housing **201** has a central channel for receiving and holding the shank of a tool bit or accessory. The end cap **204** is inserted into a central opening in the distal end of the inner housing **201**. The end cap **204**, shown in Figs. 47 and 48, has a central aperture **234** having a comparable size and to that of the shank **211** of a tool bit or accessory **212**. The end cap **204** has an inner surface, which is on an incline relative to the axis of the tool.

[0048] Within the sleeve **224**, an inclined plate **220** is biased against the angled inner surface of the end cap **204** by a spring **230**, when the sleeve **224** is in a released position as in Fig. 31. The inclined plate **220** has a central aperture **222** shaped to receive the shank and having a smaller axial opening when angled relative to the axis of the tool. This smaller axial opening grips the shank of the tool bit or accessory when the inclined plate is in the angled position.

[0049] When the sleeve **224** is retracted away from the end cap **204**, as in Fig. 30, the sleeve pulls the plate towards the inner housing **201**, compressing the compression spring **202**, and straightening the plate **220** to an angle at or closer to a 90-degrees to the axis of the tool, allowing for the removal or insertion of the shank of a tool bit or accessory. The spring **230**, shown in detail in Figs 36-38, is also compressed when the inclined plate is straightened. Fig. 31 shows the chuck **200** when the sleeve is in the locked position and the shank of the tool bit being gripped by the inclined plate **220**. In this position, the spring returns to its original shape and butts against the inclined plate **220**.

[0050] The spring preferably has an upright loop **231** and an inclined loop **232** and a spring tang **233**. The spring tang **233** juts out from the external surface of the upright loop **231**. At one end of the upright loop **231**, the inclined loop **232** and the spring tang **233** are connected to the upright loop **231** on opposite sides of the upright loop **231**. The inclined loop **232** of the spring **230** is pushed towards the upright loop **231** when the inclined plate **220** is straightened as the sleeve is retracted. The spring tang **233** is

inserted into a corresponding hole **206** in the inner housing **201**, thereby preventing the spring **230** from moving away from the inner housing **201** when the sleeve **224** is retracted or released.

[0051] Figs. 39 and 40 show views of the inner housing. The inner housing **201** has a threaded central channel **203** for joining to the rotary tool, and a machined channel into which the shank **212** of a tool bit or accessory **211** fits. The outer surface of the inner housing **201** has an annular shoulder **205** where the compression spring **202** and the sleeve **224** fits over the inner housing. The inner housing **201** also has an end portion **210** with a central channel **226** into which the end cap **204** fits. The end portion **210** has two slots **207**, **208** in the housing, radially opposite one another. The first slot **207** is axially longer than the second slot **208**. The protuberances **222** of the inclined plate **220** shown in Figs. 45 and 46, fit into these slots **207, 208**. The protuberance in the first elongated slot **207** moves along the slot **207** when the sleeve **224** is retracted and released.

[0052] Figs. 41 and 42 show views of the sleeve. The sleeve **224** is an annular ring, preferably made of metal, and is preferably knurled to help the user grip the sleeve when retracting it. The sleeve has an shoulder **225** to limit the movement of the sleeve **224** on the shoulder **205** of the inner housing.

[0053] As seen in Figs. 43 and 44, the tool shank **212** preferably has a machined or otherwise flattened portion **218** to allow for torque transfer between the inclined plate **220** and the tool bit or accessory **211**. The central channel **206** of the inner housing **201** as shown in Fig. 40, the central aperture **234** of the end cap **204** as shown in Fig. 48, and the central aperture **222** of the inclined plane **220**, as shown in Fig. 46, all preferably have a similar shape as the machined shank **218**.

[0054] If desired, then as shown in Figs. 30 to 33, the end of the tool shank **212** may be provided with a flattened tongue **213** which fits in a correspondingly-shaped slot **209** in the inner housing **201**, to provide greater torque to the tool bit or accessory **211** than might otherwise by possible through just the angled plate. Figs. 34 and 35 show the tool shank **214** without the flattened tongue and the inner housing without the corresponding slot.

[0055] Figs. 45 and 46 show views of the inclined plate. The inclined plate **220** is preferably a ring of metal with a central aperture **222** shaped to accommodate a shank **212** from a tool bit or accessory **211**. The inclined plate **220** preferably has at least two

protuberances **221** jutting out in radially opposite locations from the circumference of the plate. These protuberances rest in the first elongated slot **207** and the second slot **208** on the end portion **210** of the inner housing **201**.

[0056] Turning to Figure 49, yet another embodiment of a chuck for use with a rotary tool is shown. This embodiment is similar to the one described above with respect to Figures 1 to 7 with the difference being that the chuck does not include an inclined plate. Furthermore, the inside face of the end cap **26** may be smooth. This embodiment operates in a manner identical to the embodiment described in Figures 1 to 7.

[0057] Figure 50 is a sectional view of a further embodiment of a chuck for use with a rotary or power tool.

[0058] In another embodiment, the shank of the tool bits or accessories may include notches on the shank to provide additional means of retention (as with standard power bits for screwdrivers) whereby the inner housing comprises notch receiving means located within said central channel for receiving the notches on the shank.

[0059] Furthermore, the chuck **100** may include a collapsible collet inside the torsion spring **16.** The collet is placed inside the spring and distributes the holding forces along the length of the shank of the tool bit or accessory.

[0060] In yet another embodiment, the chuck **100** further comprises means for attachment with a router or drywall cutting tool such as a Roto-Zip attachment.

[0061] An advantage of using a multi-sectional torsion spring instead of a single piece is that possible to substitute it with other biasing means that provide the same torque requirements such as a standard torsion spring, or perhaps springs having irregularly-spaced coils that optimize torque application.

[0062] Another embodiment may be to use separate springs for clockwise and counter-clockwise torque applications. Currently, most rotary tools operate in a clockwise rotation. However, it may be necessary in the future to require rotation in the counter-clockwise direction.

[0063] Centrifugal mechanisms, such as a scissor mechanism, a dog lock or fly-weights may also be used to tighten the grip of the torsion spring around the shank of the tool bit or accessory during use.

[0064] It will be understood that depending on the type of centrifugal movable means, the inclined face **58** may be a wall which is perpendicular to the cross-section **60**.

[0065] The chuck may further comprise an expansion spring near the end cap that expands when the central tang is rotated by the helical cam, to prevent the sleeve from returning to its normal position before the shank is installed.

[0066] In order to determine if the shank of the tool bit or accessory has been inserted to the correct depth, the chuck may further comprise means for recognition/detection of the insertion depth of the shank such as via a transition element.

[0067] To ensure a consistent internal diameter of the torsion springs, since there is typically a fair degree of variance in the manufacturing process, the internal diameter of the torsion springs may be altered by various methods such as grinding, machining or honing. In some cases, very little metal may be removed, and in other cases more. An added advantage of this operation is that it in effect flattens the inner surface of the springs, providing more surface area for contacting the shank.

[0068] Conventional springs have a round cross-section, resulting in "lines" of contact between the spring and the piece to be gripped. Springs having different cross-sections may also be utilized, such as square, rectangular, etc. When these are used, the area of contact is larger and the effective gripping force increases.

[0069] In yet another embodiment, if the key is not integrally formed as part of the sleeve, both the cylindrical tube and the sleeve have alignment slots for receiving a key. The size of the key is manufactured such that its length is longer than the length of each slot so that the key does not slide out of either of the two slots.

[0070] In addition to the variations described above, for example, the sleeve could be configured so as to actuate the torsion spring by rotation of the sleeve relative to the housing, though the preferred embodiment involves axial movement of the sleeve as described above.

[0071] In yet another embodiment, the chuck comprises an expandable and collapsible device actuated by the sleeve that may be either manually biased or spring biased. When the sleeve is pulled in one direction, the device expands permitting tool bit removal and replacement of another tool bit. When the sleeve is urged in the opposite direction, the device grips the shank of the tool bit and locks the shank in position eliminate the need for a torsion spring. The end of the tool shank may be provided with flats or a non-circular shape that fits into a correspondingly shaped recess on the housing to provide additional drive. The expansion and gripping actions of the device may also be achieved by rotational movement of the sleeve.

[0072] Conventionally, chucks are designed to accommodate to shanks of tool bits or accessories of varying size, whereas one aspect of the present invention is related to chucks and tool bit shank combination of a fixed size conforming to known tolerance ranges for manufacture.

[0073] The above-described embodiments of the present invention are intended to be examples only. Alterations, modifications and variations may be effected to the particular embodiments by those of skill in the art without departing from the scope of the invention, which is defined solely by the claims appended hereto.